Oscillatory functions and phasors

Plot the following oscillatory functions of time in Excel. Include at least two full oscillations. All amplitudes are in meters. To do this make a column labeled time starting at 0 and incrementing a small amount in each cell below. Then make a column for the function and create a formula in each cell below which calculates the value of the function for the time in the neighboring cell.

(A) $2\cos(\pi t/2)$

(B) $1.5\sin(\pi t/2)$

(C) $2.5\sin(\pi t/2 - \pi/4)$

A useful way to represent oscillatory functions is by thinking of them as the *x*-components of vectors with their tails anchored at the origin, that rotate counterclockwise with frequency ω, called phasors. These are drawn at time $t = 0$ in an x-y plane, and are labeled with their rotational frequency ω. Their length is given by the amplitude A of the oscillatory function they represent, and their angle φ relative to the positive *x*-axis is determined by the phase angle φ needed to write the phasor in the form $x(t) = A\cos(\omega t + \varphi)$. The advantage of this approach is that oscillatory functions with the same frequency can be added to each other by vector addition of the phasors that represent them.

(D) Rewrite (if necessary) the functions represented in A) and B) in the form $A\cos(\omega t + \varphi)$. Draw phasors on an x-y coordinate system that represent the functions from (A) and (B).

(E) Use vector addition to draw the resultant phasor that represents $A\cos(\omega t + \varphi) = 2\cos(\pi t/2) + 1.5\sin(\pi t/2)$.

(F) Measure the amplitude and phase angle of the resultant and compare the measurements to calculations of the resultant's amplitude and phase angle.